

GROUNDWATER INFORMATION SHEET

Tetrachloroethylene (PCE)

The purpose of this groundwater information sheet is to provide general information regarding a specific constituent of concern (COC). The information provided herein relates to wells (groundwater sources) used for public drinking water, not water served at the tap.

GENERAL INFORMATION	
Constituent of Concern	Tetrachloroethylene (PCE)
Aliases	Tetrachloroethene, Perchloroethylene, Carbon Dichloride, Perchlor, Antisol, Ankilostin
Chemical Formula	C ₂ Cl ₄
CAS No.	127-18-4
Storet No.	34475
Summary	The current State Maximum Contaminant Level (MCL) for PCE is 5 micrograms per liter (µg/L). Common anthropogenic sources of PCE include discharges related to dry cleaning operations and metal degreasing processes. Based on GeoTracker public well data from 2004 to 2014 there are 190 active and standby public groundwater sources (12,744 public wells tested) that have had at least one detection of PCE above the MCL (5 µg/L). Most detections occur in Los Angeles, San Bernardino, Sacramento and Butte counties.

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REGULATORY AND WATER QUALITY LEVELS		
Type	Agency	Concentration
Federal MCL	US EPA ¹	5 µg/L
State MCL	SWRCB ²	5 µg/L
Detection Limit for Purposes of Reporting (DLR)	SWRCB ²	0.5 µg/L
Public Health Goal (PHG)	OEHHA ³	0.06 µg/L

¹US EPA - US Environmental Protection Agency

²SWRCB: The California Department of Public Health Drinking Water Program was transferred to the State Water Resources Control Board Division of Drinking Water in 2014.

³OEHHA – Office of Environmental Health Hazard Assessment

SUMMARY OF DETECTIONS IN PUBLIC DRINKING WATER WELLS⁴	
Detection Type	Number of Wells
Number of active and standby public wells ⁵ with PCE detections	PCE was detected in 662 wells (12,744 tested)
Number of active and standby public wells with PCE concentrations > 5 µg/L	Concentrations detected above the MCL in 190 public wells
Top 4 counties with PCE detection in public wells above MCL	Los Angeles(133), San Bernardino(15), Sacramento (5) and Butte(5)

⁴Based on 2004-2014 Public well (groundwater source) data (GeoTracker GAMA).

⁵Water from active and standby public wells is typically treated to prevent exposure to chemical concentrations above MCLs. Data from private domestic wells and wells with less than 15 service connections are not available.

ANALYTICAL INFORMATION	
Analytical Test Methods	US EPA Methods 502.2, 524.2, 551.1, 8260B
Detection Limit	0.5 µg/L
Known Limitations to Analytical Methods	Sample must be cooled to 4 °C upon collection, analyzed within 14 days and free of air bubbles.
Public Drinking Water Testing Requirements	Groundwater sources must be initially monitored for PCE during four consecutive quarterly sampling events. If PCE is not detected the groundwater system must take annual samples for a minimum of three consecutive years. The groundwater system may then reduce monitoring to one sample per each compliance period. The compliance period, in the case of no detections, may be up to six years.

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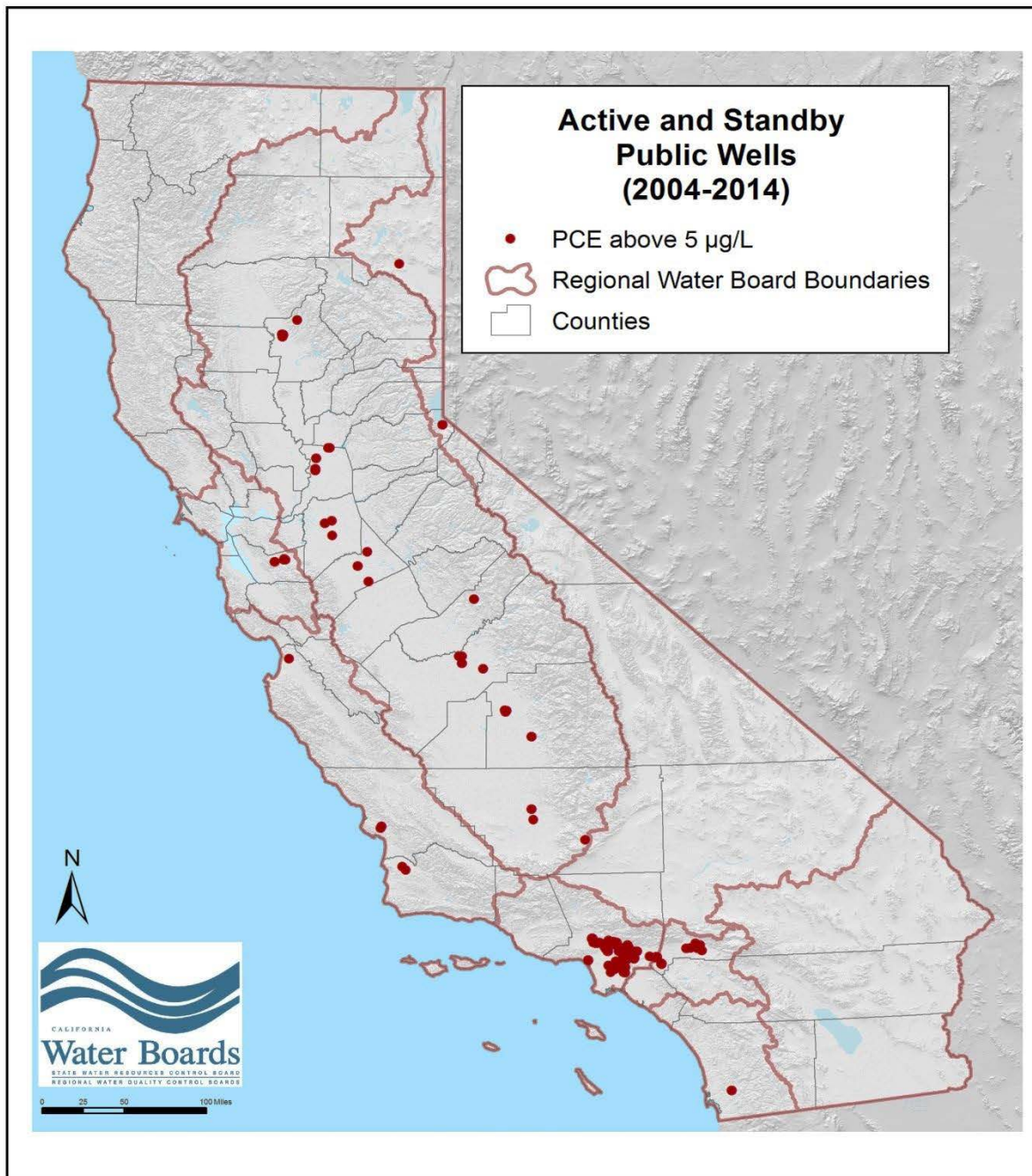
PCE OCCURRENCE	
Anthropogenic Sources	PCE is a contaminant in the environment associated with dry cleaning, textile operations, and metal degreasing activities. It was also widely used in the production of CFC-113 (Freon-113) and other fluorocarbons. PCE is also used in rubber coatings, solvent soaps, printing inks, adhesives and glues, sealants, polishes, lubricants and pesticides.
Natural Sources	PCE is a manufactured chemical and does not occur naturally in the environment.
History of Occurrence	PCE has been used as a metal degreaser by military services and industry since the 1940s. Later, PCE was also used in dry cleaning processes. Due to poor handling and disposal practices, solvents such as PCE and trichloroethylene (TCE) entered the environment through evaporation, leaks and improper disposal. There are approximately more than 400,000 sites in the US where soil and ground water are contaminated by chlorinated solvents. In California, numerous solvent plumes have originated from dry cleaning facilities in the Central Valley, Southern California and San Francisco Bay Area.
Contaminant Transport Characteristics	Mobility of PCE is described as moderate (Fetter 1988) with an average solubility in groundwater of 200 mg/L, and a soil-water partition coefficient (K_{oc}) of 152. PCE is a dense non-aqueous phase liquid (DNAPL). A DNAPL is denser than and immiscible in water. In the presence of water it will form a separate phase. The half-life degradation rate in groundwater is estimated to be between 1 to 2 years, based on aqueous aerobic biodegradation (Howard et al 1991) but may be considerably longer under certain conditions.

REMEDATION & TREATMENT TECHNOLOGIES	
Groundwater Remediation	Treatment of groundwater containing PCE includes traditional pump-and-treat technology (using air stripping or activated carbon filtration), <i>in situ</i> chemical oxidation with peroxide or ozone, de-chlorination by Hydrogen-Releasing Compound (HRC) and emerging biodegradation techniques. An important part of PCE DNAPL remediation is source removal. This is accomplished often by integrating various methods of DNAPL mobilization using co-solvents, surfactants or thermal treatment and subsequent source removal - either by pump and treat or air sparging and soil vapor extraction. The bacteria strain (Dehalococcoid 195, <i>Cornell University</i>) preferentially uses PCE as a source of energy. Slow natural biodegradation of PCE may occur under anaerobic conditions when microorganisms are acclimated. However, the biodegradation process degrades PCE to TCE and eventually to vinyl chloride, which are also considered human carcinogens.
Drinking Water and Wastewater Treatment	Drinking water can be treated by various in-line processes. Traditionally, air stripping and activated carbon filters are used to remove PCE and other volatile organic carbons (VOCs) from water. Ultra-violet radiation is also used for low-flow systems. Wastewater treatment plants use chemical oxidation and are increasingly using biodegradation processes to remove VOCs from water.

HEALTH EFFECT INFORMATION
<p>Acute: At levels above 200 mg/L in air PCE may cause eye irritation and light-headedness; above 400 mg/L, eye and nasal irritation, lack of coordination within 2 hours; 600 mg/L, dizziness within 10 minutes; 1500 mg/L, extreme irritation to eyes and respiratory tract, dizziness within 2 minutes, unconsciousness within 30 minutes.</p> <p>Chronic: Long-term exposures in drinking water above the MCL (5 µg/L) can cause adverse effects to the liver, kidneys, and central nervous system. Prolonged dermal exposure can cause irritation, dryness, and dermatitis.</p> <p>Carcinogen: Scientific evidence shows PCE may cause cancer from prolonged exposure even at levels below the MCL. The US EPA classifies PCE as a probable human carcinogen. The calculated PHG of 0.06 µg/L represents a negligible risk of contracting cancer from drinking water containing PCE in a household environment over a lifetime.</p>

KEY REFERENCES

1. California Environmental Protection Agency. Office of Environmental Health Hazard Assessment. Public Health Goal for Tetrachloroethylene in Drinking Water. August 2001 http://www.oehha.ca.gov/water/phg/pdf/tce_f.pdf
2. California State Water Resources Control Board. GeoTracker-Groundwater Database
<http://geotracker.waterboards.ca.gov/gama/>
3. Howard, H. Philip, et.al, Environmental Degradation Rates.1991. Lewis Publisher
4. ITRC. DNAPL Source Reduction: Facing the Challenge, April 2002
<http://www.itrcweb.org/Guidance/GetDocument?documentID=19>
5. Yinjie J. Tang, Shan Yi, Wei-Qin Zhuang, Stephen H. Zinder, Jay D. Keasling, and Lisa Alvarez-Cohen, Investigation of Carbon Metabolism in "Dehalococcoides ethenogenes" Strain 195 by Use of Isotopomer and Transcriptomic Analyses,
6. Regional Water Quality Control Board, Central Valley Region. July 2008. *A Compilation of Water Quality Goals*. Prepared by Jon B. Marshack.
http://www.waterboards.ca.gov/water_issues/programs/water_quality_goals/index.shtml
7. U.S. Environmental Protection Agency, Technology Innovation Office, Contaminated Site Clean-Up Information [http://www.clu-in.org/contaminantfocus/default.focus/sec/Dense_Nonaqueous_Phase_Liquids_\(DNAPLs\)/cat/Overview/](http://www.clu-in.org/contaminantfocus/default.focus/sec/Dense_Nonaqueous_Phase_Liquids_(DNAPLs)/cat/Overview/)
8. U.S. Environmental Protection Agency. Chemical Summary for Perchloroethylene. August 1994. EPA 749-F-94-020a.
http://epa.gov/opptintr/chemfact/s_perchl.txt
9. U.S. Environmental Protection Agency. Office of Water. *Technical Fact Sheet: Tetrachloroethylene*. (Sept. 2002)
<http://www.epa.gov/ODWDW/dwh/t-voc/tetrachl.html>



**Active and Standby Public Wells with at least one PCE detection
above the 5 µg/L MCL (190 wells)**

Source: August 2014 query of public well data using GeoTracker GAMA